GRC-414-III

AD HOC 144-III SPACE COORDINATION

FIRST INTERIM PROGRESS REPORT

February 9, 1976

Headquarters
National Aeronautics and Space Administration
600 Independence Avenue, S. W.
Washington, D. C. 20546

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Prepared by Direction of:

E. L. Eaton
Office of Tracking and Data Acquisition

Headquarters
National Aeronautics and Space Administration
600 Independence Avenue, S. W.
Washington, D.C. 20546

I. INTRODUCTION

The Space Coordination task of Ad Hoc 144-III requires reporting, at timely intervals, progress in the technical preparation for the 1979 General World Administrative Radio Conference, and analysis and coordination of the prepared U. S. CCIR, TSC and Government Agency documents relating to space and the tasks of Ad Hoc 144-III. This interim report documenting progress to date, is the first of several planned reports, which will evolve into a final report prior to the 1979 GWARC.

The interim report explains the background and purpose, the plan of attack, schedules, analysis, and results to date. Appendix A is a catalog of U. S. CCIR documents, developed for this report, referencing the applicable Article and/or Appendix of the Radio Regulations, and containing abstracts of the U. S. CCIR documents. Appendices B, C, D, E and F are key documents referenced herein, supplied for information purposes.

II. BACKGROUND AND PURPOSE

Document GRC-209 outlines the requirement to provide technical coordination in Ad Hoc 144-III for the 1979 GWARC. There are four categories, with a coordinator assigned to each (Space, Mobile, Spectrum Utilization, and Propagation). NASA was assigned the responsibility for the coordination of the tasks concerning Space. The purpose of the coordination is as follows:

1. Insure the timely completion of tasks assigned by Ad Hoc 144-III.

2. Identify activities planned and/or underway which bear upon the completion of assigned tasks.

3. Insure that the U. S. positions are supported by appropriate CCIR and/or other technical documentation in a timely fashion.

4. Identify areas of deficiencies in the cognizant areas of responsibility, and make recommendations for rectifying such deficiencies.

III. COORDINATION (SPACE PLAN)

The Space Coordination approach, as presented at the Ad Hoc 144-III November meeting is as follows:

1. Catalog the stated space-related responsibilities of Ad Hoc 144-III, within the broadly defined tasks in GRC-86/2 and within the listing in GRC-137.

2. Catalog and review technical documentation pertinent to these Ad Hoc 144-III assignments, including foreign documents as available.

3. Prepare a matrix which will reveal problem areas. Review and resolve omissions and/or duplications by discussion with the Chairmen of various U. S. Study Groups and the TSC Working Groups.

4. Interface with the following individual groups:

   a) CCIR USSG Chairmen

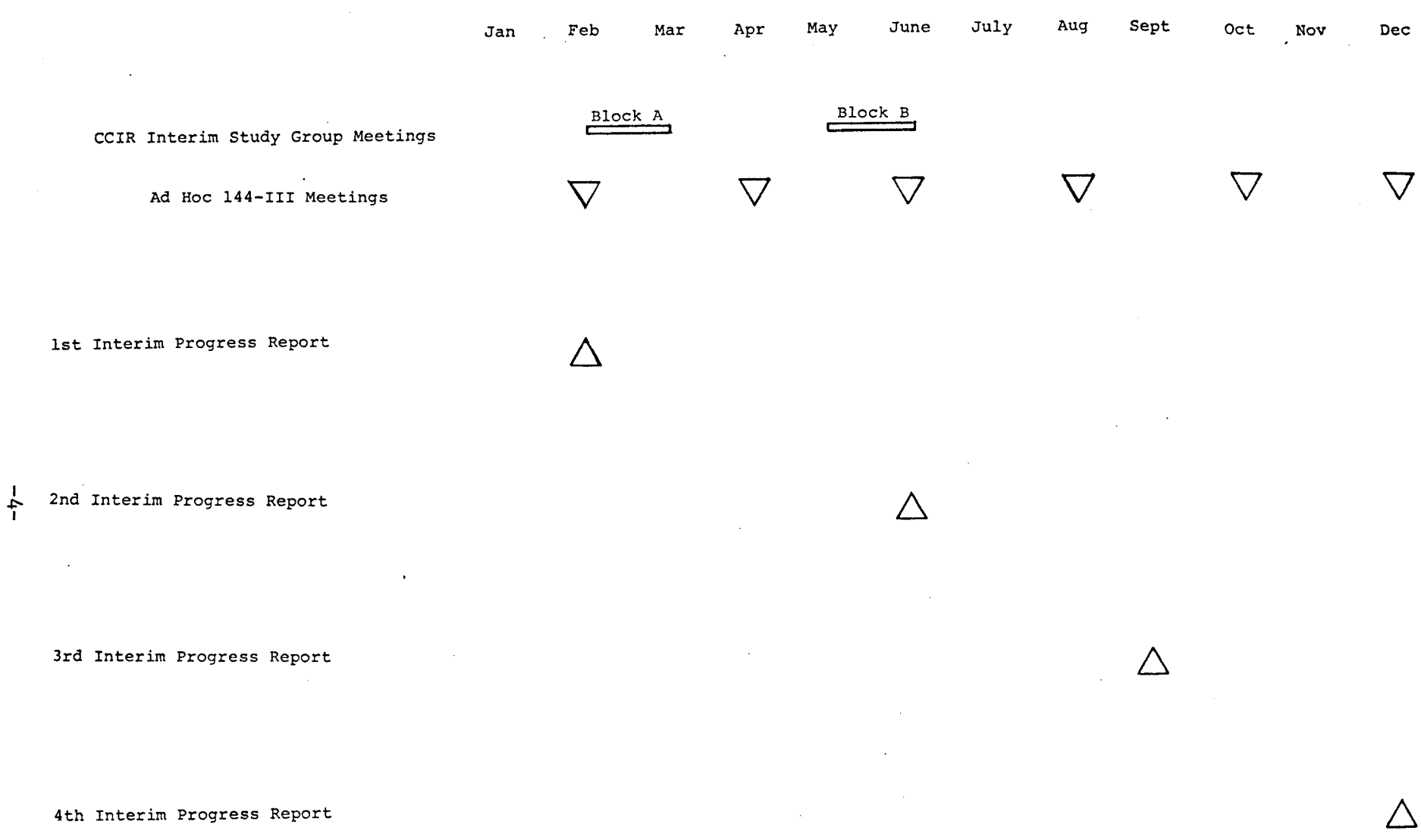
   b) Chairmen of the five TSC Working Groups

   c) Leaders for any tasks assigned directly by 144-III

   d) The three other 144-III coordinators (Mobile, Spectrum Utilization and Propagation)

   e) Frequency Management Offices of other Government agencies.

In implementing this plan it was decided to synopsize or abstract space-related technical activities for which Ad Hoc 144-III is responsible, to support categorization, analysis and coordination. Completed abstracts are shown in Appendix A.



SCHEDULE OF REPORTS FOR 1976

IV. ANALYSIS

Examination and abstracting of the CCIR papers received to date has been initiated using a matrixing approach exemplified by Figure 1. This is constrained at this time due to such factors as the deadline for submission of papers for the second session of the Interim Meetings being 1 February 1976, the limited published results of the TSC Working groups, and the limited published studies relating to the technical aspects of the radio regulations being conducted by the Government agencies. At this time some 250 documents have been received and categorized. Abstracts have been prepared for about 50.

Significant additional progress is expected in the next four months, in that results of the Interim meetings of all CCIR Study Groups, and first results of the FCC preparatory groups should be available, along with planned studies by some Government agencies at least in preliminary form.

Preliminary analysis of the available CCIR papers indicates the following:

- Changes or studies pertaining to Article 2 of the Radio Regulations are very limited. Opinion 44 of CCIR Study Group 1 anticipates that the new method, already under trial, will be included in the Radio Regulations, and asks Administrations for comments resulting from studies and trials of the method. Within the U. S., difficulties have been experienced applying the method. It therefore appears that the U. S. should address this matter.

- Within the Study Groups of CCIR, and to a limited extent in TSC, there are a considerable number of studies and reports pertaining to Article 7 of the Radio Regulations. A review indicates that some modifications or additions to Article 7 should be forthcoming.

- Indications are that at the present time Appendices 3, 4 and 5 of the Regulations are not covered by any work of the TSC or CCIR Study Groups. In all probability, this situation will change as the results of the CCIR Interim meetings become available.

- Appendices 28 and 29 of the Regulations appear to be well covered by reports in the CCIR, however, no studies could be located in TSC which propose revisions to these Appendices. It is expected that the interim meetings of the CCIR will provide additional material. However, it appears that considerable effort will be needed to convert these reports into specific modifications or additions with justifications to Appendices 28 and 29.

It would appear that in the technical space coordination activities of Ad Hoc 144-III it will be necessary to include the task of abstracting foreign submissions to the CCIR to determine their impact on the Regulations and on the U. S. National position.

V. RESULTS

Initial results of the space coordination activity indicate that work relating to the technical aspects of a majority of the space Radio Regulations is under way. However, further efforts are necessary to convert this work into specific modifications or changes to the Regulations with justifications thereof.

The following are two examples of results highlighted by the coordination process to date. First, with respect to Article 12; Paragraph 673 of Article 12 says in part:

> "Every effort should be made to keep frequency tolerances and levels of spurious emissions at the lowest values which the state of the technique and the nature of the service permit."

The minimization of spurious emissions is, of course, a basic ingredient of more efficient spectrum utilization. Its importance has been highlighted recently in the matter of energy spillover into radio astronomy bands, and in comments responding both to FCC Notice of Inquiry 20271 (WARC-1979) and Notice of Inquiry 20468 (WARC-1977) concerning minimization of spillover energy in any adjacent bands. (See GRC-284-III, Appendix E .)

Spurious emission is defined in RR 92 as:

> "Emission on a frequency or frequencies which are outside the necessary band (see RR91) and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions and intermodulation products, but exclude emissions in the immediate vicinity of the necessary band, which are a result of the modulation process for the transmission of information."

Specific tolerances for spurious emissions, given in Appendix 4 of the Regulations, are quite brief, and its language indicates that it has probably not been modified since 1959. Moreover, it describes specific tolerances only up to 235 MHz; for transmitters operating above 235 MHz, Appendix 4 states:

> "For these transmitters the levels of spurious emissions shall be as low as practicable."

Specific cases of spurious emissions which have occured recently indicate that extension of Appendix 4 is in order, to extend the range of specific emission limits into the UHF and SHF ranges. The specification and application of state-of-the-art standards at higher frequencies should not impose a serious burden on system design, since the regulations are not apt to become effective until 1981 or 1982 and since even then they may well contain a grace period for application of new standards. Also, the definition of spurious emission should be modified to include emissions in the immediate vicinity of the necessary band which result from the modulation process. The minimum ratio of occupied bandwidth to base bandwidth should be chosen which does not significantly impair the transmission characteristics of the desired system. The only documentation available which addresses this matter is a paper originating in the Standards Working Group of the TSC, which is a proposed addition to the OTP Rules and Regulations and which redefines these terms in more current terminology.

A second result is related to the problem of interference to Radio Astronomy from Services operating in adjacent bands. This problem has been under study ever since the WARC-1971, when some airborne and space services were allocated frequency bands adjacent to RA bands.

Radio Regulation 116A provides some protection, but Report 224-3 lists desired protection values far in excess of those afforded under 116A.

Some weeks ago a Recommendation was received, porposed by France (Doc. 2/24), that:

> "the frequency assigned to any station in a given service operating in a band adjacent to a band allocated to the radioastronomy service should be sufficiently separated from the limits of the band allocated to that service to ensure that, having regard to the frequency band assigned to the station and the technical arrangements made in the station to reduce out-of-assigned-band radiations, the power radiated within and at the limit of the band allocated to the radioastronomy service does not produce interference harmful to a station of that service, harmful interference levels being defined in Tables I and II of Annex I to Report 224-3."

Obviously, a U. S. position is needed regarding this Recommendation. One approach could be that such a Recommendation is regulatory rather than technical and thus beyond the purview of the CCIR. However, a compromise position has been proposed that the French recommendation be modified as shown in Appendix F. This compromise does not include the Table in Report 244-3 in the recommendation itself. This proposal was generated by the Radio Astronomy Sub-committee and presented and discussed at CORF on January 30. The results were presented at the U. S. National Committee meeting of CCIR on February 5, and the draft position paper was accepted.

It was also noted that the quasi-regulatory aspect of recommendations is not without precedent in the CCIR, and should not therefore be used as a basis for dismissing the regulation out of hand.

These two examples indicate that the coordination process is necessary and effective.

It should be re-emphasized that these are only initial and preliminary reactions to the documentation, which are subject to change as a result of further analysis and future developments.

APPENDIX A

SPACE COORDINATION - CATALOG OF DOCUMENTS

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - U. S. STUDY GROUP 1

REFERENCE	DOC. NO.	TITLE
Art. 12	1/1	Definition of a Measure of Spectrum Use
Art. 12	1/2	An Electromagnetic Compatibility Figure of Merit for Single Channel Voice Communication Systems
Art. 12	1/3	Measurement Procedures for an Electromagnetic Compatibility Figure of Merit for Single Channel Voice Communications Systems
Art. 12	1/4	A Model for Generating Interference Free Frequency Lists
N/A	1/5	Definitions of Radio Interference
Art.12	1/6	Application of the Receiver RF Non-Linear Modeling-Technique Described in Report 521
Art. 12	1/7	Provisional Signal-to-Interference Protection Ratios Required for Spectrum Utilization Investigations
Art. 12	1/8	Non-Coherent Receiver Performance Model
Art. 12	1/9	Co-Channel Interference Effects on Multiple Phase Shift Keyed (MPSK) System Performance
NAS	1/10	Measures of Voice Transmission Performance
Art. 12	1/12	A Procedure for Modeling Receiver Intermodulation Characteristics
Art. 12	1/13	System Models for the Evaluation of Interference
NAS	1/14	Response of Broadcast and Television Receivers to Impulse and Quasi-Impulsive Interference
N/A	1/15	Use of Data on Radio Noise
N/A	1/16	Man-made Radio Noise

REFERENCE	DOC. NO.	TITLE
Art. 12	1/18	Methods for the Measurement of Radio Interference and the Determination of Tolerable Levels of Interference
N/A	1/19	Limitations of Unwanted Radiation from Electrical Apparatus and Installations
N/A	1/20	Cooperation with the International Special Committee on Radio Interference
N/A	1/21	Handbook for Monitoring Stations
N/A	1/22	Cooperation Between Monitoring Stations
N/A	1/23	Antennae for Monitoring Stations
N/A	1/24	Direction Finding at Monitoring Stations
N/A	1/25	Expeditious Method of Determining Field Strength at Monitoring Stations
N/A	1/26	Visual Monitoring of the Radio Frequency Spectrum
N/A	1/27	Accuracy of Field Strength Measurements at Monitoring Stations

PRELIMINARY DRAFT

SPACE COORDINATION - U. S. STUDY GROUP 2

Subgroup A

REFERENCE	DOC. NO.	TITLE
Art. 7	2/200	Sharing of Radio-Frequency Bands by Links Between Space Research Earth Stations and Space Research Spacecraft and Between Other Space Services
Art. 7	2/201	Frequency Sharing Between Radio Systems for Space Research
N/A	2/202	Telecommunication Requirements for Manned and Unmanned Deep-Space Research
Art. 7, App. 28	2/203	Characteristics and Factors Affecting Feasibility of Frequency Sharing Between Research Satellite Systems and Terrestrial Systems
Art. 7, App. 28	2/204	Feasibility of Frequency Sharing Within and Among Space Networks Using Earth Satellites in the Space Research Service
Art. 7, App. 28	2/205	Feasibility of Frequency Sharing Between Deep-Space Research Systems and Other Space Systems
Art. 7, App. 28	2/206	Space Research Telecommunications Links
Art. 7	2/208	Preferred Frequency Bands for Deep-Space Research Manned and Unmanned Spacecraft
Art. 7	2/210	Preferred Frequency Bands for Space Research
N/A	2/211	New Definition Deep/Near Earth Space Research Services
Art. 7, App. 28	2/213	Feasibility of Frequency Sharing Between Space Research Systems Using the Same Space Research Bands
Art. 7	2/214	Telecommunication Links for Manned and Unmanned Near-Earth Research Satellites

REFERENCE	DOC. NO.	TITLE
Art. 7	2/215	Study of Preferred Frequency Bands for Near-Earth Manned and Unmanned Spacecraft
Art. 7	2/216	Telecommunication Requirements for Manned and Unmanned Near-Earth Space Research
Art. 7, App. 28, App. 29	2/217	Deep-Space Research: Characteristics and Factors Affecting Frequency Sharing With Other Services
Art. 7	2/218	Preferred Frequency Bands for Deep-Space Research
Art. 7, App. 28	2/219	Frequency Sharing Between Deep-Space Research Earth Stations and Other Stations of all Services
Art. 7	2/220	Preferred Frequency Bands for Deep-Space Manned and Unmanned Spacecraft
Art. 7	2/221	Telecommunication Links for Manned and Unmanned Deep-Space Research
Art. 7, App. 28	2/400	Sharing Possibilities Between Space Research Spacecraft in Eccentric Orbits and Deep-Space Research Earth Stations

SPACE COORDINATION - U. S. STUDY GROUP 2

Subgroup B

REFERENCE	DOC. NO.	TITLE
Art. 7	2/250	Preferred Frequency Bands for Spacecraft Transmitters Used as Beacons
N/A	2/253	Protection of Electronic Equipment From Radio-Frequency Radiation From Space Research Earth Stations
Art. 7	2/254	Effects of Multiple Access by Space Research Spacecraft to a Space Research Data Relay Satellite
Art. 7, App. 28	2/255	Antennae for Space Research Systems
Art. 7, App. 28	2/256	Radiation Diagrams of Antennae at Space Research Earth Stations for Use in Interference Studies
Art. 7, App. 28	2/257	Earth Station Antennae in the Space Research Service
Art. 7, App. 28	2/258	Generalized Space Research Earth Station Antenna Radiation Pattern for Use in Interference Calculations, Including Coordination Procedures, in the Frequency Range 1-40 GHz
Art. 7	2/259	Space Systems Technology in the Space Research Service: Attitude Control Technology
Art. 7	2/261	Preferred Frequency Bands for Spacecraft Transmitters Used as Beacons
Art. 7	2/265	Effects of Plasmas on Communications with Spacecraft
App. 29	2/266	Study of Efficient Use of Various Orbits for Space Research, Considering Polarization Diversity, Orbit Spacing and Link Diversity

REFERENCE	DOC. NO.	TITLE
N/A	2/267	Probability of Hazards to Aircraft From Deep-Space Earth Stations
Art. 7	2/268	Analysis of Long-Term Satellite Visibility Statistics
Art. 7	2/269	The Maximum Time a Satellite Spends in the Beam of an Earth Station

SPACE COORDINATION - U. S. STUDY GROUP 2

Subgroup C

REFERENCE	DOC. NO.	TITLE
Art. 7	2/300	Technical and Operational Considerations for the Earth Exploration Satellite Services

The need for wide band data links due to high resolution multispectral sensors is addressed as is the need for a data telemetry band between the current 8025-8400 MHz and 21.2-22.0 GHz allocations (see 2/307 for more detail). Power flux density limits which may restrict the applications planned for EES (see Report 2/308) and passive and active microwave remote sensing considerations (see Report 2/305 and 2/304 respectively) are highlighted in this Report.

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

New Report

Art. 7	2/301	Radiocommunications for Meteorological Satellite Systems

This paper has, and continues to be, a general tutorial paper on NASA's meteorological program. It includes some discussions of link frequencies of various operational and planned METSATs.

Added this year was a discussion of remote sensing instrumentation and its impact on the need for increased data link bandwidths. A general discussion of active and passive microwave remote sensors for METSATs, along with currently used frequencies, was also added.

This document is for general information purposes and has no direct effect on Art. 7.

Draft Revision of Report 395-2

REFERENCE	DOC. NO.	TITLE
Art. 7	2/302	Technical and Operational Considerations for the Earth Exploration Satellite Service: Geodetic Satellite System

A general discussion is given covering present and near-future geodetic satellite systems such as GEOS-2 and -3, SEASAT, LAGEOS and Geopause. Techniques discussed are laser ranging, long-baseline interferometry, altimetry, scatterometry, radiometry and satellite-to-satellite tracking.

The Report discusses: 1) the possible need for future communication links in Band 10, 2) the fact that active sensing experiments are incompatible with existing PFD limitations, and 3) the highlights of passive and active remote sensor needs in geodetic satellite systems (see Report 2/305, 2/304 respectively).

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

New Report

Art. 7	2/303	Radiocommunication Systems for Earth Exploration Satellites

This revised Study Programme discusses considerations to be given to the Earth Exploration Satellite Service.

Of particular importance is the inclusion this year of a call for consideration and determination of the needs and sharing criteria for active and passive microwave remote sensors.

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

Revision of Study Programme 12A/2

REFERENCE	DOC. NO.	TITLE
Art. 7	2/304	Technical and Operational Considerations for the Earth Exploration Satellite Service: Frequency Sharing Criteria for Active Microwave Sensors

A computer program for calculating ground PFD's was developed to simulate a spaceborne active radar. The program was run for a 1000 km orbit, 2 kw transmitter power, 10 and 300 MHz RF bandwidths and a generalized, representative gain envelope.

The analysis indicated that active sensors, as presently configured will produce power flux densities considerably greater than allowed by the ITU in the fixed services. This may preclude their operation in these bands. However, it is desirable to determine whether existing PFD limits are applicable. Radiolocation bands, though, present more attractive sharing possibilities than the fixed services, but need further study.

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

New Report

Art. 7	2/305	Technical and Operational Considerations for the Earth Exploration Satellite Service: Frequency Sharing Criteria for Passive Microwave Sensors

Passive remote sensors are high sensitivity microwave receivers and are used to measure emitted radiation from the earth's environment.

A computer model of a passive microwave radiometer was developed. A harmful level of interference of 20% of the receiver's sensitivity (ΔT) was used in the analysis along with a generalized, representative antenna. For comparison radio astronomers use 10% of ΔT as an interference criteria.

REFERENCE	DOC. NO.	TITLE
		The conclusion reached was that research and experimentation with passive sensors may be conducted in many bands of the spectrum with varying degrees of interference, using currently allocated service bands. In some cases, the space research (passive) and radio astronomy bands would be satisfactory from an interference viewpoint; however, the bandwidths are not now sufficiently broad to be totally satisfactory. Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7. New Report
Art. 7	2/306	Earth Exploration Satellites: Data Collection and Location Systems Current data collection and location systems -- OPLE on ATS-3, IRLS, RAMS, LandSat and SMS data collection systems -- are generally discussed. Types of satellite position location systems -- ranging, angle, rate and radiolocation -- are briefly presented. The best frequency compromise with present day developed technology, it is felt, is the 400.15-403 MHz region. Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7. New Report

REFERENCE	DOC. NO.	TITLE
Art. 7	2/307	Technical and Operational Considerations for the Earth Exploration Satellite Service: Radiocommunication Frequency Selection Considerations

In recognition of the potential usefulness of earth exploration satellites, the 1971 WARC-ST allocated frequency bands for telemetering data from earth exploration satellites in Band 10 (8025-8400 MHz and 21.2-22.0 GHz). Further study of these requirements indicates that the optimum band for this function may be between these two allocations (see Report 2/308 for more detail). The purpose of this Report is to present the factors which influence the selection of frequencies for transmissions of wideband data from earth exploration satellites.

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

New Report

Art. 7	2/308	Technical and Operational Considerations for the Earth Exploration Satellite Service: Power Flux Density Considerations for Radiocommunication Systems

Applications planned for earth exploration satellites may be restricted by the power flux density limits which apply to the frequency bands used by the satellites' radiocommunication systems (8025-8400 MHz and 21.2-22.2 GHz). The purpose of this Report is to present the power flux density levels needed by earth exploration satellites in order not to restrict the growth and utilization of the EES service.

Technical information in this document will assist in determining PFD limits in frequency bands shared between EES and other space or terrestrial services for inclusion in Article 7.

New Report

REFERENCE	DOC. NO.	TITLE
Art. 7 Art. 12	2/309	Wireless Energy Transmission

Transmission of energy by electromagnetic radiation may be of great value. Recent development work has demonstrated the technical possibilities of wireless energy transmission. However, at such high powers, antenna sidelobes and harmonic transmitter frequencies can produce harmful interference. A new question, thus seems appropriate.

Assuming these transmitters operate in IS&M bands already allocated for this purpose then there are no direct impacts on Article 7; however, due high e.i.r.p. spurious responses (Article 12) must be considered.

New Question

Art. 7	2/310	Radiocommunications for Satellites - Serviced Data Collection Systems

The use of satellites to relay data from earth-based remote sensing platforms has been shown to be feasible. Consequently a new Question seems appropriate. Questions to be addressed are: 1) the service, if any, where generalized earth based data collection systems should operate, 2) up-link and down-link frequency requirements, and 3) sharing criteria.

Technical information is needed to assist in determining PFD limits in shared bands for inclusion in Article 7.

New Question

SPACE COORDINATION - U. S. STUDY GROUP 2

Subgroup D

REFERENCE	DOC. NO.	TITLE
Art. 7	2/350	Characteristics and Factors Affecting Frequency Sharing and Other Services
Art. 7	2/351	Factors Affecting the Possibility of Frequency Sharing Between Radio-astronomy and Other Services
N/A	2/352	Protection of Frequencies Used For Radioastronomical Measurements
Art. 7	2/356	Factors Affecting the Possibility of Frequency Sharing Between Radar Astronomy and Other Services
N/A	2/357	Line Frequencies, Arising From Natural Phenomena, of Interest to Radio-astronomy and Related Sciences

SPACE COORDINATION - U. S. STUDY GROUP 2

Subgroup E

REFERENCE	DOC. NO.	TITLE
Art. 7	2/401	Preferred Frequency Bands for Use in Maintenance Telemetering, Tracking and Telecommand of Developmental and Operational Satellites
Art. 7	2/402	Use of Space Research Frequency Bands as Multiple Direction Bands
Art. 7	2/403	Use of Space Research Frequency Bands as Multiple Direction Bands
Art. 7	2/404	Technical Feasibility of Frequency Sharing in the Amateur Satellite Service

SPACE COORDINATION - U. S. STUDY GROUP 3

Note: Dr. Hass advised that Study Group 3 is not initiating any papers by itself, but is associating itself with two papers on selective calling, originating in U. S. Study Group 8.

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - STUDY GROUP 4

REFERENCE	DOC. NO.	
Art. 7	4/1	Diversity Delay

The signals from the two stations of a diversity pair will have different time base at the switching point. With some loose constraints on station location, this difference can be held to 20 μs or less, for spacings of 20 km. Satellite motion will cause this delay to vary by ±0.5 to ±0.75 μs around its nominal value. The report derives the magnitude of the delay, describes its effects on analog and digital signal transmissions, and discusses the need for differential delay equalizations.

Information Report

App. 29	4/2	Design Considerations for Intersatellite Links

The report identifies some of the emerging needs for intersatellite communications links and relates them qualitatively to factors enhancing the spectrum utilization of the geostationary orbit. The report also identifies some of the major technical issues that will need to be addressed in further system design considerations.

New Report

App. 29	4/3	Satellite Antenna Patterns in the Fixed Satellite Service

Report 558 discusses satellite antenna design techniques and performance requirements including side and main lobe characteristics, orbit utilization, and effects of side lobe reduction and presents for further study a reference radiation diagram for use in interference studies.

This document, 4/3, presents revised sections as follows:

REFERENCE	DOC. NO.	TITLE
		Replaced second sentence of last paragraph of Section 3.1 with description of potential sidelobe radiation falling outside the earth's rim (~17°) and interfering with spacecraft operating with reversed up and down-link frequencies. Added new figure for example of side lobe radiation beyond earth's rim. Added new annex entitled "Beam Shaping by Combining Multiple Feeds in a Common Parabolic Reflector".
		Revision of Report 558
App. 29	4/4	Polarization Discrimination by Means of Orthogonal Circular and Linear Polarization

Report 555 discusses the use of orthogonal polarization to provide increased capacity of the geostationary orbit. The factors which are discussed include cross polarization discrimination obtainable in different frequencies, the characteristics of polarizers, the depolarizing effects experienced in the atmosphere and ionosphere, the stability of satellite orientation and the implementation of polarization tracking.

The changes which Doc. 4/4 present are: Insert new section 2 describing relative advantages of linear polarization. Changed old section 2 number and title to:
3. Polarization Discrimination Performance for Satellites or Earth Station Components
Replaces old paragraph three, four and five of this section with new material presenting measured data of cross polarization contours for conical horns and conical horn reflector.

Added new paragraph,"3.2, Polarizers" to replace "Section 3. Polarizers" including extensive re-write describing current work in the field.

Deleted Section 4, and revised Section 5 as:

REFERENCE	DOC. NO.	TITLE
		"4, Environmental Factors Affecting Polarization Discrimination". Re-numbered paragraphs with second paragraph under new 4.3 describing the effects of rain-induced differential attenuation and phase shift on cross polarization for circular polarization. Added paragraph, "4.4 Polarization Tracking for Linear Polarization".
		Revision of Report 555
Art. 7	4/5	Coupling Factor Between a Large Earth Station Antenna and a Small Antenna Located in its Geometrical Shadow
		A relatively simple formula is derived for estimating the coupling factor that exists between a large earth station antenna and an isotropic antenna located on the rearward projection of its focal axis. Predictions based on the formula are compared to actual measurements made in the field. The magnitude of the on-axis coupling factor, which appears to be worst case value, can be predicted reasonably well from the formula despite the complexity of the actual situation where back-up structure, pedestal, elevation shaft, buildings and the ground itself can be expected to distort the results.
		New Report
App. 29	4/6	Frequency Considerations for the Intersatellite Service Between Geostationary Space Stations
		Optimal frequency ranges for Intersatellite Service links are discussed in some detail. It is concluded that for antenna sizes greater than about 0.28 meters, the optimum frequencies for non-tracking intersatellite links lie in the range between 3 and 30 GHz, the larger antenna sizes favoring the lower frequencies.
		New Report

REFERENCE	DOC. NO.	TITLE
App. 29	4/7	Technical Factors Affecting the Efficiency of Use of the Geostationary-Satellite Orbit by Radio Communications Satellites Sharing This Same Frequency Band Report 453 in the "basic" and continuing report of the findings of IWP 4/1, efficient use of the geostationary orbit, which contains the general conclusions of the IWP on its main topics.
App. 29	4/8	The Effect of Multiple Band/Service Satellites on Orbit and Spectrum Utilization The way in which band allocations and services are combined on individual spacecraft may have an effect on the utilization of the geostationary orbit. An analysis of this effect involving various homogenous potential combinations of a multiband satellite is presented. It is concluded that unless carefully done, substantial losses in orbit-spectrum utilization may result.
Art. 7	4/9	Systems in the Fixed Satellite Service For Frequency Division Multiplex Telephony and Television Report 208-3 describes the form of the hypothetical reference circuit and allowable noise standard, the video bandwidth and sound channel for television. The revisions in 4/9 consist of inclusion of an updated section on allowable noise power limits in place of paragraph 2 of section 2.1 of the report. Revision of Report 208-3
Art. 7	4/10	Experiments on Collocated Antennas Results of Comsat tests are presented in support of the analysis presented in Doc. 4/5 concerning antenna coupling between an earth station and its associated interconnect radio-relay link operating in the same frequency bands. The test results confirm the feasibility of frequency reuse for these systems without undo interference or excessive constraints. Further, the test provided data on coupling between two antennae with large apertures, each in the the other's near field. New Report

REFERENCE	DOC. NO.	TITLE
Art. 7	4/11	Earth Station Design 14/11 GHz

Study of configuration for a 14/11 GHz earth station in light of a particular set of rain attenuation statistics and desired performance level. Link margins for fading and overall degradation are presented for the up-link and down-link cases in terms of percentage of time for both non-diversity and space diversity configurations.

New Report

Art. 7	4/12	14/11 GHz Diversity Earth Station Configuration

Technical factors affecting the configuration of a 14/11 GHz diversity earth station are presented. Several potential diversity configurations are studied and conclusions drawn.

New Report

Art. 7	4/13	Diversity Interconnection Link Design

Presentation of a diversity interconnection link (DIL) design configuration band upon detailed technical considerations. The design allows for frequency reuse and presents detailed DIL system parameters as well as link budget calculations.

New Report

Art. 7	4/14	Interference Considerations in a Digitally Modulated Communications Satellite System

Communications satellite systems have operated in either bandwidth or power limited modes. However, future systems may become interference limited due to the introduction of frequency re-use techniques within given systems. Simultaneously, digital modulation may become thedominant modulation technique utilized. It is desirable to establish tolerable interference limits for digital modulation so that acceptable performance may be realized. The relationship between the RF interference parameters and

REFERENCE	DOC. NO.	TITLE
		the effect on digital communications performance is the subject of this paper containing results of a laboratory hardware simulation.
		New Report
App. 29	4/15	Bandwidth and Orbital Arc Utilization of Satellite Communications Systems Employing Mixed Earth Stations
		The use of earth stations with small antennas is of increasing interest because of the cost for communications service expansion in developing nations; communications services to remote areas; educational and other public service functions to large user communities; and emergency communications for disaster relief. Developments in satellite and related technologies have resulted in the capability to support such communications using small earth stations. The use of such stations can be expected to increase. However, the characteristics of such stations (particularly antenna discrimination) tend to reduce the utilization of bandwidth and orbital arc as compared to that achieved by larger stations.
		This Report analyzes the principal factors affecting orbit spacing with mixed earth stations, and how these can be manipulated to reduce orbit spacing.
		New Report
Art. 7	4/16	Interference Allocation of a Digital System in the Fixed Satellite Service
		The use of digital modulation has already been used in satellite systems in the Fixed Satellite Service. The most extensive application will be in frequency bands above 10 GHz where rain attenuation begins to contribute significant fading. As a result, the service may have to be switched to diversity earth stations in order to maintain acceptable error performance.
		The interference coordination of these systems is different than analog systems. The system will be designed to limit the

REFERENCE	DOC. NO.	TITLE
		error rate to a tolerable level even at the switch point. Consequently, if the switch point requirement is met, the error performance during normal propagation conditions is negligibly small.
		New Report
Art. 7, App. 29	4/17	Sharing Between Fixed-Satellite and Broadcasting-Satellite Services at 12 GHz
App. 29	4/18	Efficiency of Use of the Geostationary - Satellite Orbit: Concepts and Definitions

The efficient use of the geostationary-satellite orbit and the frequency spectrum in the Fixed-Satellite Service is recognized as an important goal but what constitutes efficient use of the orbit-spectrum resource is a complex question. Discussion of this problem can be found in Report 453-1. The need for further investigation into this subject is well recognized by the CCIR.

The number of technical factors affecting geostationary-orbit utilization suggests the potential difficulties attending a comprehensive formulation of efficiency. The complexity of this subject is increased by the effect of non-technical considerations. That is, economic, social, and cultural factors are also important aspects. However, since the CCIR deals only with technical aspects, it becomes necessary to consider only those aspects of efficiency. Progress in this area would be furthered by a careful separation and precise definition of concepts that have been previously used loosely and interchangeably. Such clarification might lead to better understanding of the concept of efficiency of orbit-spectrum utilization, and permit the adoption of Recommendations on the subject which would foster the efficient use of this resource. It is the intention of this Report to attempt to clarify the issues involved.

New Report

REFERENCE	DOC. NO.	TITLE
Art. 7, App. 29	4/19	Technical Factors Influencing the Efficiency of Use of the Geostationary-Satellite Orbit by Radiocommunication Satellites Sharing the Same Frequency Bands (General Summary)
Art. 7	4/20 (BC-825)	Orbit-Spectrum Sharing Between the Fixed-Satellite and the Broadcasting Satellite Services in the Band 11.7-12.2 GHz
App. 28	4/21	Determination of Coordination Area
App. 29	4/22	Limitations on Off Angle e.i.r.p. Density by Earth Stations in the Fixed-Satellite Service

Studies relating to earth station e.i.r.p. density as contained in Report 386-2 have dealt solely with the requirements of systems in the Fixed-Satellite Service with particular emphasis on establishing limits which would adequately protect terrestrial radio-relay systems. This material was initially prepared in 1966, and while modified in 1970 and 1974, no significant changes were made.

Studies related to spectrum orbit utilization have received extensive attention since the formation of IWP 4/1 in 1968 and several Recommendations have been developed for technical criteria between and among systems in the Fixed-Satellite Service using the geostationary satellite orbit.

This Report presents an updating of the material of Report 386-2 and adds new information related to the requirements for e.i.r.p. density, particularly where small stations may be used. The intent of the information is to permit the development of recommendations of the off-beam e.i.r.p. density requirements for earth stations which will provide reasonable operational capability for the most likely requirements while maintaining adequate protection to terrestrial systems and other satellite

REFERENCE	DOC. NO.	TITLE
		systems. It is important that such limits result in orbit utilization which meets critical tests of efficiency while permitting reasonable conditions for utilization by many newly developed services. New Report
App. 29	4/23	Use of the Geostationary-Satellite Orbit (Method of Calculation to Determine Whether Two Geostationary-Satellite Systems Require Coordination)
Art. 7, App. 29	4/24	Utilization of Small Earth Stations in Satellite Systems The effects of a small diameter earth station, particularly using digital voice activated single channel per carrier technique, on an adjacent system using high capacity large earth stations are discussed in this Report. These systems are assumed to operate to a common coverage area with satellites having a 4° separation. New Report
Art. 7	4/25	Sharing Between Radio Location and Down-Links of the Fixed-Satellite Service The frequency band of 3400-3700 MHz is allocated in Regions 2 and 3 on a co-equal basis to space-to-earth links of the Fixed-Satellite Service and the Radiolocation Service. PFD limits are specified in RR 470 NM, 470 NN and 470 NO for all Regions. However, this band has only been used to a limited extent and in light of the increasing requirements for satellite communications, it appears that the conditions for sharing should be studied to determine whether the band could be used. While a preliminary analysis, the potential for sharing appears to lead to reasonable constraints on PFD without undue difficulties arising in earth station coordination. New Report

REFERENCE	DOC. NO.	TITLE
App. 29	4/26	Measures of Orbit-Spectrum Utilization
App. 28	4/27	Radiation Diagrams of Antennae for Earth Stations in the Fixed-Satellite Service for Use in Interference Studies

This document is introduced for information only. It describes the measured gain pattern characteristics of an antenna with $D/\lambda < 100$. The antenna is 2.44 m (8 ft) in diameter operating in the 7-8 GHz region.

Measurements were made at 7.5 GHz for both co and opposite polarization and with antenna elevation angles of 7.5 and 45 degrees. Instrumentation provided an effective dynamic range of 70 dB.

Art. 7	4/IWP-76	Spacecraft Antenna Pointing Errors

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - STUDY GROUP 5

REFERENCE	DOC. NO.	TITLE
App. 28	5/1	Propagation Factors Affecting the Determination of Coordination Distance between 1 and 40 GHz
N/A to Space	5/2	Estimation of Transmission Loss for Terrestrial Interference Paths at Frequencies above 1 GHz
N/A to Space	5/3	Influence of the Non-Ionized Atmosphere on Wave Propagation
N/A to Space	5/4	Diffraction Over a Spherical Earth
N/A to Space	5/5	Radiometeorological Data
Art. 7	5/6	Influence of the Non-Ionized Atmosphere on Wave Propagation
N/A to Space	5/7	Propagation Data Required for Line-of-Sight Radio Relay Systems
Art. 7	5/8	Propagation Data Required for Space Telecommunications Systems
N/A to Space	5/9	Propagation Via Atmospheric Layering
N/A to Space	5/10	Ground Wave Propagation
N/A to Space	5/11	Influence of the Non-Ionized Regions of the Atmosphere on Wave Propagation

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - STUDY GROUP 6

REFERENCE	DOC. NO.	TITLE
N/A to Space	6/1	Summary of Recommended Actions Proposed by the USA
N/A to Space	6/2	Choice of Basic Indices for Ionospheric Propagation
N/A to Space	6/3	Observations Needed to Provide Basic Indices for Ionospheric Propagation
N/A to Space	6/4	Choice of Basic Indices for Ionospheric Propagation
N/A to Space	6/5	Short-term Prediction of F_oF2
N/A to Space	6/6	Short-term Predictions of Operational Parameters for Ionospherical Radio-communications
N/A to Space	6/7	Identification of Precursors Indicative of Short-term Variations and Evaluations of the Reliability of Short-term Forecasts of Ionospherical Propagation Conditions
N/A to Space	6/8	Exchange of Information for the Preparation of Short-term Forecasts and the Transmission of Ionospheric Disturbance Warnings
N/A to Space	6/9	Ground and Ionospheric Side-Scatter
N/A to Space	6/10	Basic Prediction Information for Ionospheric Propagation
N/A to Space	6/11	Ionospheric Sounding at Oblique Incidence
N/A to Space	6/12	Draft Revision of Report 261-3 Back-Scattering
N/A to Space	6/13	Long-Distance Ionospheric Propagation without Intermediate Ground Reflection

REFERENCE	DOC. NO.	TITLE
N/A to Space	6/14	Methods of Systematic Measurement of Sky-Wave Field Strength and Transmission Loss at Frequencies above 1.5 MHz
N/A to Space	6/15	Comparisons between Observed and Predicted Sky-Wave Field Strength and Transmission Loss at Frequencies Between 2 and 30 MHz
N/A to Space	6/16	Estimation of Sky-Wave Field Strength and Transmission Loss at Frequencies Between 2 and 30 MHz
N/A to Space	6/17	Estimation of Sky-Wave Field and Transmission Loss at Frequencies above 1.5 MHz
N/A to Space	6/18	Estimation of Sky-Wave Field Strengths and Transmission Loss at Frequencies above 1.5 MHz
N/A to Space	6/19	Estimation of Sky-Wave Field Strength and Transmission Loss Above 1.5 MHz
Art. 7	6/20	Radio Noise
N/A to Space	6/21	Measurement of Atmospheric Radio Noise from Lightning
N/A to Space	6/22	Radio Noise Within and Above the Ionosphere
N/A to Space	6/23	Man-Made Radio Noise
N/A to Space	6/24	Geographic Distribution and Program of Regular Ionospheric Observations
N/A to Space	6/25	Improvement in the World-Wide Ionospheric Observing Program for Numerical Mapping Purposes
N/A to Space	6/26	CCIR Atlas of Ionospheric Characteristics
N/A to Space	6/26A	CCIR Atlas of Ionospheric Characteristics
N/A to Space	6/27	Improvement in the World-Wide Ionospheric Observing Program for Numerical Mapping Purposes

REFERENCE	DOC. NO.	TITLE
N/A to Space	6/28	Routine Ionospheric Sounding
N/A to Space	6/29	Basic Prediction Information for Ionospheric Propagation
N/A to Space	6/30	Basic Prediction Information for Ionospheric Propagation
N/A to Space	6/31	VHF Propagation by Regular Layers, Sporadic E or Other Anomalous Ionication
N/A to Space	6/32	Prediction of Sporadic E
N/A to Space	6/33	The Characteristics of Sporadic E
N/A to Space	6/34	VHF Propagation by Sporadic E
N/A to Space	6/35	Propagation Between Stations Below the Ionosphere by Ducting Above the Ionication Maximum of the F Region
N/A to Space	6/36	HF Propagation by Ducting Above the Maximum of the F Region
N/A to Space	6/37	Special Problems of HF Radiocommunication Associated with the Equatorial Ionosphere
N/A to Space	6/38	Intermittent Communication by Meteor Burst Propagation
N/A to Space	6/39	Long Distance Ionospheric Propagation without Intermediate Group Reflection
N/A to Space	6/40	Long Distance Ionospheric Propagation Without Intermediate Ground Reflection
N/A to Space	6/41	Analysis of Sky-Wave Propagation Measurements for the Frequency Range 150 kHz to 1600 kHz
N/A to Space	6/42	Sky-Wave Propagation at Frequencies Below 150 kHz with Particular Emphasis on Ionospheric Effects
N/A to Space	6/43	Ionospheric Cross-Modulation

REFERENCE	DOC. NO.	TITLE
N/A to Space	6/44	Ionospheric Modification by High Power Transmitters
N/A to Space	6/45	Ionospheric Modification by High Power Transmitters
N/A to Space	6/46	Ionospheric Modification by High Power HF Transmitters
N/A to Space	6/47	Ionospheric Propagation Characteristics Pertinent to Radiocommunication Systems Design
N/A to Space	6/48	VLF Propagation In and Through the Ionosphere
Art. 7	6/49	Ionospheric Effects Upon Earth-Space Propagation
N/A to Space	6/50	Transionspheric Radiowave Group Delay
Art. 7	6/51	Scintillation Relative to Communication Systems

PRELIMINARY DRAFT

SPACE COORDINATION - STUDY GROUP 7

REFERENCE	DOC. NO.	TITLE
Art. 7	7/100	Some U. S. Satellite Experience Plans Relevant to the 1971 WARC Satellite Frequency Allocations
N/A to Space	7/101	Instability of Standard Frequency Generators
N/A to Space	7/102	Intercomparison of Time Scale by Various Methods
Art. 7	7/103	Relativistic Effects in a Terrestrial Coordinate Time System
N/A to Space	7/104	Summary of 1975 Survey of WWV/WWVH Users
N/A to Space	7/105	Frequency and Time Stability
Art. 7	7/108	Standard Frequency and Time Signal Dissemination Via Satellites
N/A to Space	7/109	Stability and Accuracy of Standard Frequency and Time Signals and VLF and LF Bands as Received
N/A to Space	7/110	High Precision Standard Frequency and Time Signal Emissions
N/A to Space	7/111	Standard Frequencies and Time Signals

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - STUDY GROUP 8

REFERENCE	DOC. NO.	TITLE
Art. 7	8/1	Signal-to-Interference Protection Ratios and Minimum Field Strengths Required in the Mobile Services
Art. 7	8/2	Efficient Utilization of the 1535-1660 MHz Frequency Band for the Maritime Mobile Satellite Service
App. 29	8/4	Communication Channel Demand Access Methods for Maritime Mobile Satellite Ship Terminals
N/A to Space	8/6	Mobile Radiocommunications Equipment for Relief Operations
Art. 7	8/7	Systems Providing Radiocommunication and/or Radiodetermination Using Satellite Techniques for Aircraft and/or Ships
N/A to Space	8/8	Internal Communications On Board Ships by Means of Portable Radiotelephone Equipment
Art. 7	8/9	Noise as a Factor Affecting the Choice of Frequency for Telecommunications Between an Aircraft Ship and a Satellite
N/A to Space	8/10	Methods of Subjunctive Performance Assessment of Voice Communication System
N/A to Space	8/11	Quality Objectives for a Maritime Mobile Satellite System
N/A to Space	8/12	Systems for Radiotelephone Networks for the Land Mobile Services with Extremely Economical Frequency Utilization
N/A to 144-III	8/15	Aeronautical Technology Tests with the ATS-6 Satellite

REFERENCE	DOC. NO.	TITLE
Art. 7	8/16	Multipath Tests Results with the ATS-6 Satellite
N/A to Space	8/21	Casualty Statistics for Ocean Crossing Vessels
N/A to 144-III	8/22	Comparison of Candidate Satellite Communication Voice Modems Flight Tested with ATS-6
N/A to Space	8/23	Digital Selective Calling System at Sea Tests
N/A to Space	8/5	Technical Characteristics of Equipment and Principles Governing the Allocation of Frequency Channels Between 25 and 500 MHz for the Land Mobile Service
N/A to Space	8/14	Maritime Radar Interrogator Transponder
N/A to 144-III	8/24	Performance of Digital Data Modems Flight Tested with ATS-6
N/A to 144-III	8/25	Intelligibility Evaluation of Satellite Relay Voice Transmission System
N/A to 144-III	8/26	Maritime Technology Tests With the ATS-6 Satellite
Art. 7	8/27	Satellite-to-Ship Link Margins for a Maritime Mobile-Satellite System
N/A to Space	8/3	Digital Selective Calling System Tests on an HF Channel Simulator

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - STUDY GROUP 9

REFERENCE	DOC. NO.	TITLE
N/A to Space	9/1	Line-of-Sight Radio Relay Systems
Art. 7	9/2	Systems Using Single Sideband Amplitude Modulation at Microwave Radio Frequencies
N/A to Space	9/3	Limitation of Frequency Tolerance of Radio Relay Systems
N/A to Space	9/4	Permissible Noise in the Hypothetical Reference Circuit for Line-of-Sight Radio Relay Systems
N/A to Space	9/5	Maximum Allowable Values of Interference in a Telephone Channel of an Analogue Angle Modulated Radio Relay System
NAS	9/6	Digital Radio-Relay Systems - Use of Frequencies above about 12 GHz Channel Arrangements for the Band 38.6-40.0 GHz
ART 7	9/7	Radio-Relay Systems for Telephony-Systems Using Single Sideband Amplitude Modulation (SSB) at Microwave Radio Frequencies

PRELIMINARY DRAFT - REQUIRES
COORDINATION WITH THE CHAIRMAN

SPACE COORDINATION - U. S. STUDY GROUP 10/11

REFERENCE	DOC. NO.	TITLE
NAS	BC/101	Engineering Standards Governing the Assignment of Sound Broadcasting Stations in Band 6 (MF) in the USA
NAS	BC/103	Improving MF Coverage Efficiency by Use of Directional Transmitting Antenna
NAS	BC/104	Sound Broadcasting Systems in Bands 5, 6, and 7
NAS	BC/105 (Rev. 1)	Sound Broadcasting in Bands 5 and 6
NAS	BC/106 (Rev. 1)	Ionospheric Modification
NAS	BC/301 (Rev. 1)	Characteristics of TV Systems
NAS	BC/600	Polarization of Emissions in the Terrestrial TV Broadcasting Service
NAS	BC/700	Standards for the International Exchange of Monochrome and Color TV Programs on File
NAS	BC/701	Standards for the International Exchange of Monochrome and Color TV Programs on File
NAS	BC/702	International Exchange of TV Programs on Magnetic Tape
NAS	10/11A/703	Standards for Cartridge Tape Recording and Reproducing
NAS	BC/400	Subnyguist Encoding of PCM NTSC Color Television Signals
NAS	BC/401	Television Systems Using Digital Modulation
NAS	BC/201	Measurements of Stereophonic Parameters
NAS	BC/202	Compatibility of Stereophonic and Supplementary Subcarriers

SPACE COORDINATION - STUDY GROUPS 10/11B

REFERENCE	DOCUMENT NO.	TITLE
N/A	USSG B/C 810	Terminology Relative to the Use of Space Communication Techniques for Broadcasting
Art. 7	USSG B/C 820	Criteria to be Applied for Frequency Sharing Between the Broadcasting-Satellite Service and Other Services
Art. 7	USSG B/C 821	Criteria to be Applied for Frequency Sharing Between the Broadcasting-Satellite Service and the Other Services in the Frequency Range 2500 MHz to 2690 MHz
Art. 7	USSG B/C 822	Use of the 12 GHz Band
Art 7	USSG B/C 823	Frequency-Sharing Between the Broadcasting Satellite Service and Terrestrial Services
Art 7 App. 29	USSG B/C 825	Orbit-Spectrum Sharing Between the Fixed-Satellite and the Broadcasting Satellite Services in the Bnad 11.7-12.2 GHz
Art 12 App. 4	USSG B/C 826	Measured Emissions of the ATS-6 Satellite In the 2690-2700 MHz Band
7d	USSG B/C 827	Subjectively Measured Interference Protection Ratios for Planning Television Broadcasting Systems
7d	USSG B/C 828	Protection Ratio Measurement Procedure
Art 7	USSG B/C 829	Coordinating Broadcasting Satellites with Other Servaices
Art. 7	USSG B/C 830	System Characteristics and Protection from Interference
Art. 7	USSG B/C 831	Technical Characteristics of Systems for Community and Individual Reception

N/A	USSG B/C 832	Possible Systems and their Relative Acceptability
Art. 7	USSG B/C 833	Feasibility of Direct Television Broadcasting from Satellites
N/A	USSG B/C 834	Television Standards
Art. 7	USSG B/C 835	Digital Techniques in the Broadcasting Satellite Service
Art 7	USSG B/C 836	Technically Suitable Methods of Modulation
N/A	USSG B/C 837	Broadcasting-Satellite Service: Sound and Television (Space Segment State-of-the-Art)
N/A	USSG B/C 838	User Functional Requirements for Satellite Services
N/A	USSG B/C 839	Broadcasting Satellite Service: Sound and Television
Art 7 App. 29	USSG B/C 840	The Planning of Multiple Broadcast Transmissions from Satellites
Art 7 App. 29	USSG B/C 841	Planning Optins in Region 2
Art. 7	USSG B/C 850	Characteristics of Receiving Systems for the Broadcasting-Satellite Service (Television)
Art 7	USSG B/C 851	Characteristics of Ground Receiving Equipment for Braodcasting-Satellite Systems
Art 7	USSG B/C 870	Reference Patterms for Spacecraft Antennae in the Broadcasting Satellite Service
Art 7	USSG B/C 871	Reference Antennae Patterns for the Broadcasting-Satellite Service
Art. 5	USSG B/C 873	Frequencies for the Connection to a Broadcasting Satellite
Art. 7	USSG B/C 875	Broadcasting Satellite Service (Sound): Use of the 12 GHz Band

Art 7 App. 29	USSG B/C 876	Computer Programs for Sharing Analysis
Art 7	USSG B/C 877	Sharing Criteria in Region 2
N/A	USSG B/C 880	IWP--PLENARY/2 Manual
N/A	USSG B/C 881	Satellite Systems for Disaster Warning and Relif Operations
Art. 7	USSG B/C 883	Technical Characteristics of Systems for Community and Individual Reception
Art. 7	USSG B/C 884	Possible Sound Broadcasting-Satellite Systems and their Relative Acceptability
Art. 7	USSG B/C 885	Feasibility of Direct Sound Broadcasting From Satellites

APPENDIX B

OFFICE OF TELECOMMUNICATIONS POLICY
INTERDEPARTMENT RADIO ADVISORY COMMITTEE

FOR INFORMATION

Washington, D.C. 20005

GRC-209/1-III

Date: August 5, 1975

To: Ad Hoc 144-III

Subject: Task Coordinators

The tasks concerned with providing technical preparation for the 1979 General World Administrative Radio Conference fall into certain general categories. It is recommended that there be designated a coordinator for each of these categories. Initially there would be four coordinators, i.e., one for Space, Mobile, Spectrum Utilization, and Propagation, respectively.

The responsibilities of the coordinators would include the following:

1. Insure the timely completion of tasks assigned by Ad Hoc 144-III.

2. Identify activities planned and/or underway which bear upon the completion of assigned tasks.

3. Insure that U.S. Positions are supported by appropriate CCIR Documentation in a timely fashion.

4. Identify areas of deficiencies in the cognizant areas of responsibility and make recommendations for rectifying such deficiencies.

The coordinator for Space is NASA; for Spectrum Utilization is the Office of Telecommunications, Department of Commerce; for Mobile is the Department of Transportation, Coast Guard; and for Propagation is the Institute for Telecommunications Sciences, Department of Commerce.

D. M. Jansky
Convenor Ad Hoc 144-III

APPENDIX C

OFFICE OF TELECOMMUNICATIONS POLICY
INTERDEPARTMENT RADIO ADVISORY COMMITTEE
AD HOC 144
Washington, D.C. 20005

FOR INFORMATION-144
FOR AGENDA - 144-III

GRC-86/2

Date: October 29, 1974

To: Convenor, Ad Hoc-144-III

Subject: Technical Review of the Radio Regulations

Reference: IRAC Doc. 16199/1-3.1.24/1.4.6 (TSC-176/1-1.4.6) (CRC-7)

Attached to the reference is a list of articles and appendices of the Radio Regulations which the TSC prepared as those considered appropriate for review in preparation for the WARC-1979. This list has been reviewed by AH-144 to determine those areas on which AH-144 requires input in the development of U.S. positions for that conference. As a result of that review there is attached a series of task statements which AH-144 feels are appropriate for the initial effort in this regard.

It is recognized that Ad Hoc-144-III, in responding to many of these task statements, may draw heavily on work already accomplished by or in progress within the CCIR or may develop areas in which further CCIR effort is indicated. Through its participants representing the CCIR, Ad Hoc-144-III should insure the necessary coordination of its efforts with those of the U.S. CCIR Working Groups. The aim, of course, is to insure that, wherever necessary or appropriate, the U.S. position at the time of the WARC-1979 is supported by finished CCIR work.

In pursuing these tasks, Ad Hoc-144-III should consider what specific values will meet U.S. needs in the 1980-2000 time frame. Additionally, if the U.S. needs do not appear consistent with those of the other ITU member nations, alternative values should be provided along with the rationale therefor.

Samuel E. Probst
Convenor, Ad Hoc-144

Attachment

Ad Hoc-144-III Task Statements

Attachment

Task 1:

Review the adequacy and acceptability of the limitations contained in RR 470A through 470 MOD inclusive. Make recommendations for the preservation or modification, if appropriate, of each limitation and for the applicability of each. Include specific rationale in justification for any proposed changes.

Task 2:

Review the adequacy and acceptability of the values contained in Tables I, II, III and IV and Figures 4 through 12 inclusive in Appendix 28 of the RR. Make recommendations for the preservation or modification, if appropriate, of each and include specific rationale in justification for any proposed changes.

Task 3:

Review Appendix 3 of the Radio Regulations and develop such proposals for the specific values of frequency tolerance contained therein as may be appropriate along with technical, economic and operational rationale therefor.

Task 4:

Review Appendix 4 of the Radio Regulations and develop such proposals for the specific values of spurious emissions contained therein as may be appropriate along with technical, economic and operational rationale therefor.

FOR INFORMATION

GRC-137

APPENDIX D

OFFICE OF TELECOMMUNICATIONS POLICY
INTERDEPARTMENT RADIO ADVISORY COMMITTEE

Washington, D.C. 20005

AD HOC-144

Date: January 3, 1975

To: Convenors, AH-144Ia, 144Ib, 144Ic, 144Id, 144Ie, 144II and 144 III

Subject: Assignment of portions of the Radio Regulations

The parts of the Radio Regulations are assigned to various subgroups of AH-144 for review and preparation of U. S. Postions as indicated in the Attachment.

Where an entire Chapter is assigned, only the Chapter number is given. Where Articles within a Chapter are assigned separately, the Article numbers are given. Where Regulations within an Article are assigned separately, the Regulations numbers are given.

This supercedes the initial assignments contained in GRC-103.

Elaine E. Probst

S. E. Probst
Convenor, Ad Hoc 144

Attachment

Chapter I	
Art 1	Ie
Art 2	III
Chapter II	
Art 3	Ie
Art 4	Ie
Art 5	
125-155	Ie
10 kHz - 27.5 MHz and 156-227	Ia
27.5 MHz - 1215 MHz and 228 - 341	Ib
1215 MHz - 10GHz and 342 - 401A	Ic
10 GHz and above and 402 - 412J	Id
Art 6	II
Art 7	
422 - 470	II
470A - 470VG	III
Chapter III	Ie
Chapter IV	
Art 12	III
Art 13	III
Art 14	III
Art 15	Ie
Art 16	Ie
Chapter V	II
Chapter VI	II
Chapter VII	II
Chapter VIII	II
Chapter IX	II
Chapter X	II
App 1	Ie
App 1A	Ie
App 2	Ie
App 3	III
App 4	III
App 5	III
App 6	III
App 7	Ie

App 8	Ie
App 9	Ie
App 10	Ie
App 11	II
App 12	II
App 13	II
App 13A	II
App 14	III
App 15	Ia
App 16	II
App 17	Ia
App 17A	III
App 18	Ia
App 19	III
App 20	III
App 20A	III
App 20B	III
App 20C	III
App 21	II
App 22	II
App 23	II
App 24	Ie
App 25	Ia
App 26	Ia
App 27	Ia
App 28	III
App 29	III

Additional Radio Regulations, Resolutions, and Recommendations to be assigned later. Any changes or additions to the above necessitated by the Final Acts of the WARC-M-74 will be issued after receipt of those Final Acts.

APPENDIX E

GRC-284-III

FOR INFORMATION

H. E. Weppler
Engineering Director
Technical Policy Planning

AT&T
American Telephone and
Telegraph Company
195 Broadway
New York, N. Y. 10007
Phone (212) 393-3291

July 31, 1975

Dr. W. F. Utlaut, Chairman USSG-1
Institute for Telecommunication Sciences
Office of Telecommunications
Department of Commerce
Boulder, Colorado 80302

Dear Bill:

This is to provide some ideas for your work on the regulation of adjacent-band interference.

I am attaching copies of two specific proposals which have been made to the FCC recently by AT&T. The first pertains to the control of adjacent band interference into the 17.7-19.7 GHz band from other types of terrestrial stations operating immediately below 17.7 GHz; this was filed in connection with FCC Docket No. 20271 on the WARC-79. The second speaks to potential interference from broadcasting and fixed satellites in the 11.7-12.2 GHz band into the adjacent bands; this came up in connection with FCC Docket No. 20468 concerning the 1977 WARC.

I am hopeful that these proposals may be useful to Study Group 1 in its work. Thus far we have not initiated specific proposals in Study Group 9 on this subject, but may do so later if it appears that it would be useful.

Sincerely,

Chairman, USSG-9

Attachments

c.c.: H. Kimball
E. Dinkel

Extract from Comments of AT&T Co. in

FCC Docket No. 20271, dated February 14, 1975

Adjacent Band Interference

13. Problems of adjacent band interference typically arise where services occupying adjacent bands have widely different service objectives or disparate technical requirements. These problems have normally been accommodated by costly, time consuming, custom engineering measures applied to the respective system layouts.

14. AT&T believes the general problem deserves further study to develop recommendations and regulations on its control. Of immediate concern to AT&T is a potentially serious problem affecting the projected use of the frequency band between 17.7-19.7 GHz (18 GHz) by both high capacity satellite and terrestrial services. This band is expected to be of great economic importance to the public, especially as lower bands approach saturation. A terrestrial radio relay allocation for 18 GHz was recently adopted by the Commission.* Prototype equipments for use at these frequencies have been developed and built. Propagation data on which to engineer systems at 18 GHz is being accumulated as part of the ATS-6 experiment and further statistics are expected from AT&T experimental programs at 18 and 30 GHz. Of great importance to realizing the potential of this band is a fundamental need for complete freedom to locate system links without concern over debilitating interference from extraneous sources. Because propagation factors in this band dictate numerous, relatively inexpensive, closely spaced terrestrial relay points (2 km to 5 km), a least cost engineering and placement philosophy is essential if these systems are to be economically attractive.

15. AT&T is concerned that inadequate control during the technical and operational evolution of radiolocation equipment at frequencies in the band immediately below 17.7 GHz may have serious adverse interference and related economic impact on systems operating above 17.7 GHz. At present, the Radio Regulations by footnote "e" in Appendix 3 address this control matter for certain radar stations by specifying that ". . . the bandwidth occupied by the emissions of such stations shall be maintained wholly within the band allocated to the service. . . ." "Occupied bandwidth" is defined in No. 90 of the Radio Regulations in terms of a percentage of total mean power which is permissible beyond the occupied bandwidth. However, in view of the fact that communication systems are sensitive to the peak power of radar pulses rather than their mean power and that radars transmit such large peak powers and wide signal spectra into highly directive antennas, the potential for serious interference exists. Interference to adjacent band service allocations around 17.7 GHz must be controlled to a reasonably low level if neighboring services are to be economically viable. AT&T believes the U.S. should develop a proposal to WARC for establishment of rules specifically applicable to out-of-band emissions. It is suggested that such a regulation might be appropriately included in

* Second Report and Order in Docket No. 18920 released July 5, 1974 (74-657)

the framework of Chapter IV "Measures against Interference," Article 12 "Technical Characteristics of Equipment and Emissions." In a manner analogous to Regulation No. 470 RM, AT&T urges that adjacent band power limitations be defined in terms of an absolute level of peak power density over a given bandwidth and at a given distance. AT&T recommends that out-of-band emissions from stations operating in bands adjacent to 17.7 and 19.7 GHz be limited to approximately -120 dBW/m^2 in any 1 kilohertz of bandwidth at a distance of 1 km.

Extract from Comments of AT&T Co. in

FCC Docket No. 20468, dated July 31, 1975

Out-of-Band Emission Control:

5. To promote the use of the frequencies in the 11.7-12.2 GHz band for broadcast and fixed satellite services, it would be desirable to continue to omit detailed terrestrial coordination procedures and power flux density constraints. Nonetheless, it is imperative that the services in adjacent frequency allocations be afforded a satisfactory measure of protection from the expected high levels of the broadcast satellite signals and possible out-of-band spillover interference.

6. AT&T's concern over containment of spectral energy within the allocated band stems from the substantial increases in Equivalent Isotropically Radiated Power (EIRP) projected for 1980 and beyond. For example, NASA projects that, in the 1980's, EIRP's may exceed 90 dBW. See, CCIR Document USSG IV/E (Rev. 1) dated April 18, 1969, "Feasibility of Direct Sound and Television Broadcasting From Satellites." This would be approximately six orders of magnitude greater than the levels corresponding to permissible values of power flux density from space stations which share allocations coequally with the Fixed Service in nearby bands.

7. Inasmuch as the broadcasting satellite and fixed satellite services in the 11.7-12.2 GHz band have no emission rights in the adjacent bands, the "unavoidable" residual spillover spectral emissions from 11.7-12.2 GHz operations must be sufficiently suppressed to avoid causing significant interference to the services authorized in those adjacent bands. Power flux density studies by the CCIR have established that, in the case of a satellite system sharing the 11.45-11.7 GHz band coequally with terrestrial radio relay systems, the allowable power flux density for the satellites should be limited to values which produce, in the aggregate, approximately 1000 picowatts (pWp) of noise into a terrestrial radio relay system. Considering the foregoing it would appear that any extraneous out-of-band impact on radio relay systems from services operating between 11.7-12.2 GHz should be limited to a relatively insignificant 10 pWp0 or less. This would require levels 20 dB below the levels authorized in Radio Regulation No. 470 NQ for fixed satellite services in the adjacent bands. Accordingly, AT&T suggests that the Commission seek the adoption of a U.S. position limiting the allowable out-of-band energy radiated by broadcasting and fixed service satellites which are authorized to operate in the 11.7 to 12.2 GHz band to values at least 20 dB below those given in Radio Regulation No. 470 NQ.

1. The French draft recommendation (Doc. 1/4-2/24) would incorporate in the Radio Regulations, either directly or by reference, the harmful interference levels to radioastronomy as now defined in Tables I and II of Annex I to CCIR Report 224-3. The draft recommendation would in effect establish buffer bands within the spectrum allocations to other radio services which are adjacent to bands allocated to the radioastronomy service. It is understandable that the radioastronomers would favor such provisions in the Regulations.

2. The draft recommendation has a potential impact on other radio services, particularly the fixed, mobile ~~and broadcasting~~ satellite services, and it must be considered by all concerned Study Groups.

3. The appropriateness of such a recommendation as a recommendation of the CCIR is questionable. Although the draft recommendation is based on the application of CCIR Report 224-3, its application as proposed would be a mandate for frequency managers and thus it appears to transcend the purview of the CCIR.

U.S. POSITION

The draft recommendation as it stands cannot be supported by the U.S. delegation to the interim meeting of Study Group 2.

In any discussion of the paper, the delegation will be guided by paragraphs 2 and 3 of the discussion above.

PROPOSED UNITED STATES MODIFICATION TO THE FRENCH DRAFT RECOMMENDATION DOC. 2/24

THE C.C.I.R.,

CONSIDERING

(a) the value to mankind of the scientific results achieved by the radio-astronomy service through their exploration of the universe,

(b) the need for interference-free bands throughout the radio spectrum in order that radio astronomy measurements can be made,

(c) the levels of interference considered to be harmful by the radio astronomy service in Annex 1 to Report 224-3 for line and continuum measurements,

(d) the desire on the part of both active and passive users of the radio frequency spectrum to operate in harmony without mutual interference as evidenced by the provisions of Nos. 89, 90, 91, 92, 116 and 116A of the Radio Regulations,

(e) the difficulties currently being experienced by radio services in the design and utilization of transmitters to operate in frequency bands adjacent to a band allocated to the radio astronomy service in such a manner as to afford the maximum practical protection from harmful interference to the radio astronomy service,

(f) the probable future increase in the level of usage of frequency bands adjacent to bands allocated to the radio astronomy service, particularly by airborne and satellite transmitters,

(g) that it is incumbent on both the active and passive radio services to find means to minimize harmful interference, acting both separately and in cooperation with each other,

RECOMMENDS

(a) that all practical, technical means, such as filters, ~~in~~ to be used both in radio astronomy receivers and in adjacent band transmitters to the maximum practical extent in order to reduce harmful interference to the radio astronomy service,

(b) that when frequencies are assigned to any station in a given service operating in a band adjacent to a band allocated to the radio astronomy service, administrations should attempt to separate those frequencies from the limits of the band allocated to that service to ensure that, having regard to the frequency band assigned to the station and the technical arrangements made in the station to reduce out-of-band radiations, the power radiated within and at the limit of the band allocated to the radio astronomy service produces the lowest practical level of harmful interference to a station of that service,

(c) that administrations should continue to seek practical solutions that will minimize future levels of harmful interference in the radio-astronomy bands and are urged to propose such solutions at the General World Administrative Radio Conference in 1979.